Obducat NIL 2.5 Nanoimprinter

Version: October 18, 2023

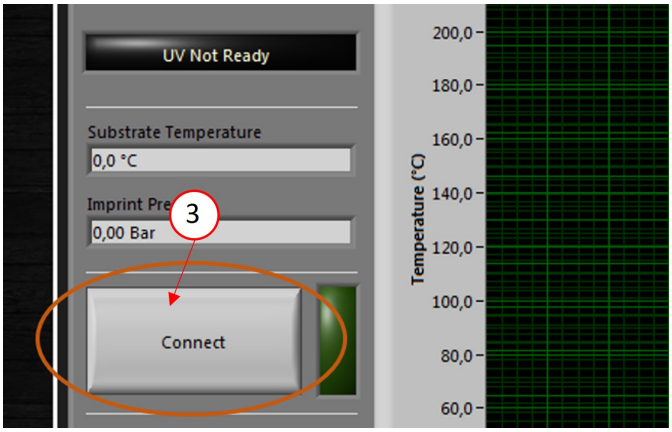
System Specifications

Maximum temperature	250 °C
Temperature setting accuracy	±2 °C
Temperature differences across active surface	±0.5%
Maxiumum pressure	70 bar

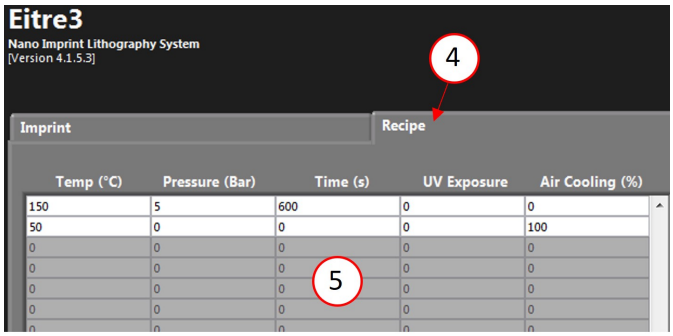
No UV-module has been installed.

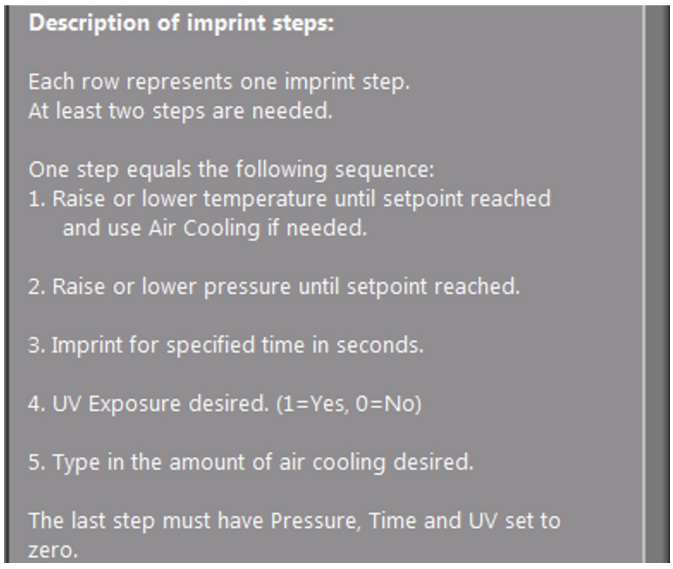
Starting the nanoimprinter and connecting to the computer

1. Turn the main switch to the **ON** position. It will take a few moments to boot.
2. Start the computer and the Eitre3 software, located on the taskbar.
3. When the screen on the nanoimprinter has turned on, press **CONNECT** in the Eitre3 software (found beneath the **Imprint** tab). The machine can now be operated using the computer.



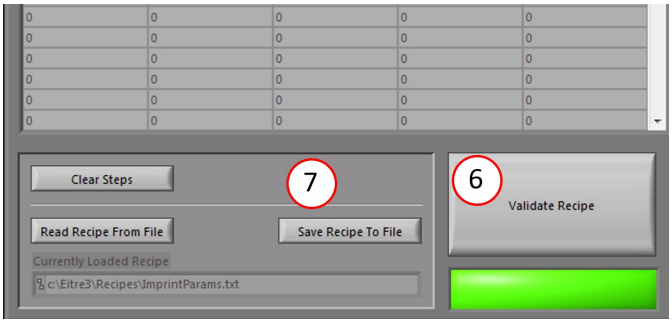
Creating your imprint recipie





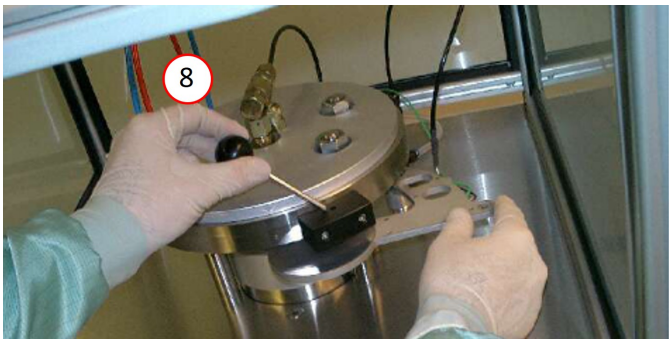
4. Enter the **Recipe** tab.
5. Enter valuse for the specific imprint recipe for your experiment including temparature, pressure, time and air cooling. Note that at least two lines need to be filled for the imprint procedure to start and that the system will run the recipie from top to bottom. In the image an example of a 10 min (600 s) imprint at 150 °C and 5 bar is illustrated, with 100% air cooling down to 50 °C. There are helpful instructions to be read to the right side of the parameters (shown in lower part of image). *Remember the maximum allowed temperature and pressure are 250 °C and 70 bar.*

6. Finally validate your recipie. Any error will be shown in a message window. If everything is OK a green light will be shown.
7. If you have a complex recipe, you may want to save it until next time.



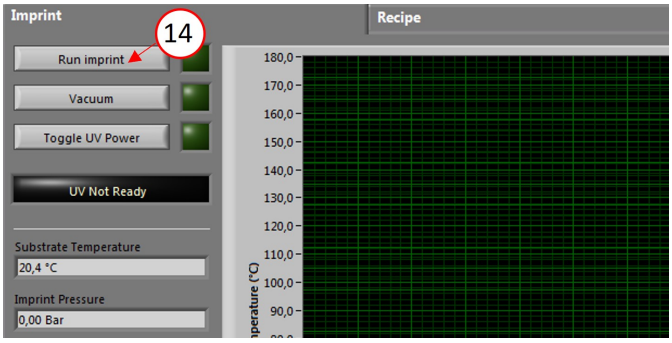
Sample loading

8. Open the protective window and withdraw the substrate holder.
9. Put your sample on the substrate holder with the mold on top.
10. If you removed the metallic O-ring, make sure that it is placed to its original position. If not, the O-ring may be destroyed during the imprint procedure.
11. Put two aluminium sheets on top. If you experience pressure loss you may need to cover sharp edges of your sample with a soft flexible material, or increase the amount of aluminium sheets used.
12. Slide the substrate holder to its original position and lock it with the pin. Double check that the aluminium sheets are still in place.
13. Close the protective window. It's magnetically locked and can be tricky to close. A tip is to hold it with your left hand, and give it a small hit with your right.



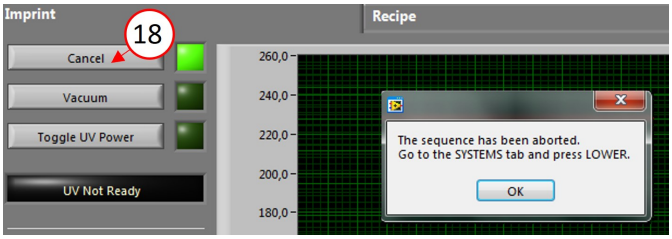
Running an imprint

14. If you're satisifed with your recipie, hit **Run imprint** in the software to start the imprinting process. A piston will then move your substrate upwards, sealing it during the imprint.
15. The full imprinting process is displayed under the **Imprint** tab on the monitor, allowing you to see how each parameters change in time.
16. When the cooling step is done, the piston will move down automatically. Open the protective window and remove your sample.
17. The sequence is saved as a logfile at a standard location, which you may move to a separate folder if the imprint procedure is of interest and should be saved.

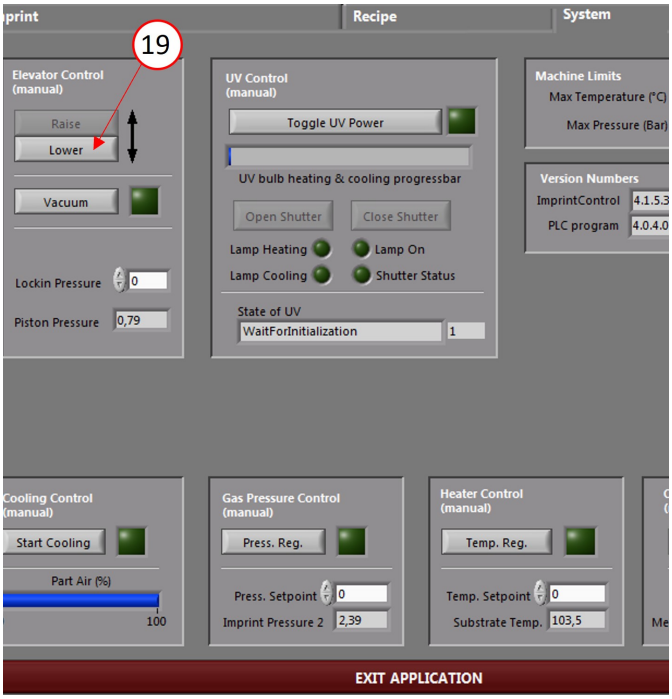


Aborting an imprint process

18. If not critically important to stop the procedure immediately (e.g. if pressure loss occurs) the process may be stopped by clicking **Cancel** under the **Imprint** tab.



19. A pop-up window will appear, telling you the sequence has been aborted, and that you need to enter the **System** tab and click on **Lower**. This is to lower the piston and let you access your substrate.



20. If it's critically important to stop the sequence immediately, press the red **STOP** button on the machine and contact the responsible person for the equipment.

Turn off machine

23. Click **Disconnect** in the **Imprint** tab.
24. Turn the main switch to **OFF** on the machine.

Replica molds in PDMS

To make a replica molds on PDMS from the silicon master stamp you need any PDMS kit (SYLGARD 184 Silicone Elastomer Kit) and Hexamethyldisiloxane ($C_6H_{18}OSi_2$, CAS: 107-46-0) for surface treatment. The surface treatment is done to form an anti-adhesive layer on the master molds and avoiding PDMS residues. Make sure to read the safety sheet for Hexamethyldisiloxane, as it is a dangerous substance.

Pre-treatment of Master molds

25. Prepare a sealable space and a holder (make sure it can withstand 75 °C). It's preferably if the bottom of the holder have holes to allow the gas to circulate close to the silicon master(s). The image show an example of a custom designed setup.
26. Place your master mold(s) on your holder and put it inside your beaker.
27. Dispence 5 ml of Hexamethyldisiloxane in the beaker using a pipette and attach the seal cover.
28. Seal the cover more, using parafilm for example.
29. Place the beaker on a hot plate at 75 °C, starting the evporation of the Hexamethyldisiloxane.
30. Put ice for cooling at the top of your setup to assist the condensation of the evaporated Hexamethyldisiloxane. Make sure to add new ice when necessery.
31. Let run for at least 6 hours, then turn off the hot plate and leave overnight.
32. If there are Hexamethyldisiloxane residues on the masters after the treatmeant, wash off with isopropanol.

Creating the PDMS molds

33. Prepare a petridish covered with aluminium foil (make sure there are no holes in the foil) or similar to avoid the PDMS getting stuck to the petridish.
34. Prepare a 10:1 mixture of the SYLGARD 184 PDMS and the curing agent in a disposable falcon tube. Make sure to mix them properly. Centrifuge for 5 min or degas to remove air bubbles afterwards. Remember to calculate the volume needed to make your molds the size you intend based on your petridish choice.
35. Place your pre-treated silicon master mold(s) in the petridish and gently pour the 10:1 mixture on top. Try to have a slow and steady flow to avoid introducing air bubbles.
36. Cure the mixture in an oven at 200 °C over night. Then let the sample cool slowly.
37. **NOTE: Be extra cautious when following the steps below to remove the master mold from the PDMS.**
1) Start by cutting a a slightly larger PDMS square around your master mold. Avoid applying unnecessery pressure to the polymer when cutting, as doing so might damage the master.
2) Flip the PDMS upside down and gently peel the aluminium from the backside of the master mold. It can be helpful to use a scalpel blade or such to gently scrape the aluminium to create a hole to work with. Make sure the backside of the master is properly free from aluminium foil by removing a litte extra on each side. Finally, check if any PDMS is attached on the backside. If so, remove it gently with the blade.
3) To remove the master mold, gently bend the PDMS in each corner, slowly releasing parts of the master. Work your way around the master until it is loose enough to be removed by tweezer. If everything works well the master usually ”pop out” from the PDMS, allowing for easy removal.
37. The pretreatment lasts at least 2-3 times.

Clean the working station after use